

## Why scintigraphy has a role in the management of the oncological patient

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Veterinary oncology is a rapid growing field because more owners are prepared to go all the way to give their pets the maximal care, including extensive interventions with radiation and chemotherapy. As a consequence, pre-therapeutic evaluation of the patient becomes more important to obtain a complete picture of the disease, to predict survival chances and to select the most appropriate therapeutic protocol. Subsequent to the initial diagnosis, assessment of loco-regional or distant metastases (staging) is mandatory to predict prognosis for survival and to direct therapy strategies. Nuclear imaging modalities have the capacity to evaluate the viability and metabolism of tissue. It also offers the possibility to image the whole body in search of metastases, in a relative short acquisition time.

Pre-therapeutically, this technique is therefore used particularly for imaging and staging of malignancies and guidance of treatment possibilities. Post-therapeutically, this modality is also used to monitor therapy results and to visualize recurrence of the tumour at an early stage. Computed tomography (CT) and magnetic resonance imaging (MRI) may have superior spatial resolution, they are not very useful for the identification of residual tumour tissue in the early post-therapy phase. Also, metabolic tumour response precedes changes in size because radiation and chemotherapy initially influence the metabolism of the tumour prior to size alterations, the last being the hallmark for therapy evaluation with structural imaging modalities. This is an important feature in view of early evaluation of therapy outcome, and when necessary allows early decision making on therapy strategy adaptations. The ability to visualize tumour cells is due to the specific characteristics of tumour cells compared to normal cells. Specific markers for increased metabolism, neoangiogenesis, receptor/transporter upregulation, apoptosis, P-gp pumps etc have been labelled with a variety of radionuclides for PET and SPET.

Especially in oncologic imaging, the quality (described by “target to background” or “signal to noise ratio” and resolution) of the generated images must be high, in order to detect lesions as small as possible. Tomographic acquisitions (Positron Emission Tomography (PET); Single Photon Emission Tomography (SPECT)) will improve lesion detection as background radioactivity from over- and underlying tissues is removed. Higher doses of injected radioactivity and the use of highly selective radiopharmaceuticals may improve sensitivity.

A specific class of radionuclides is used for local therapy of the tumour. Their strength lies in the fact that they deposit high amounts of energy in a small tissue range with radiobiological damage mainly confirmed to the target cells (i.e. tumour cells) thereby sparing normal tissue. These radionuclides and radiopharmaceuticals will accumulate in, or bind specifically with the tumour cells (the target). In contrast with conventional radiotherapy, where a specific region of the body is irradiated, targeted

radionuclide therapy also has the potential to treat widely disseminated malignancies and micrometastases. Another important advantage is that the same pharmaceutical can be used, if labelled with different classes of radionuclides, to stage tumours as well as to treat them. This lecture will focus on the working mechanism and common indications of conventional radiopharmaceuticals used in human and veterinary oncology. Ongoing human research concerning the development of new generations of radiotracers will also be discussed. Reports in the veterinary literature on these newer radiotracers are scarce and mostly limited to staging of the disease. Prospective studies comparing the clinical additional value of nuclear medicine to structural imaging for different types of tumours in the different clinical settings (pre- and post-therapy) are lacking. Extrapolating data from human oncology to veterinary oncology is not always evident. Knowledge of species and tumour dependent issues concerning the distribution and binding characteristics of the radiopharmaceuticals is necessary. This is especially true in receptor imaging where species and tumour type variations in expression of receptors may occur. Reasons for the small number of veterinary studies probably are limited access to scintigraphic and especially PET modalities, radioprotection issues and financial restrictions concerning the use of more expensive radiopharmaceuticals.

Despite these limitations, nuclear imaging may provide important information about the extent of the disease, the prognosis and therapeutic management. Similar to humane medicine, therapy strategies may be influenced by the results of these imaging studies, thus leading to early therapy adjustments and avoiding useless treatment. Therapy with radiotoxic compounds may be extended in the future beyond radioiodine for the thyroid.

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